

Approved by:

_____/_____/_____
Process Engineer_____/_____/_____
Equipment Engineer

1 SCOPE

The purpose of this document is to detail the use of the Lam 4600. All users are expected to have read and understood this document. It is not a substitute for in-person training on the system and is not sufficient to qualify a user on the system. Failure to follow guidelines in this document may result in loss of privileges.

2 REFERENCE DOCUMENTS

- Material Safety Data Sheets for Process Gases
- Rainbow 4600 System Operation Rev. 1

3 DEFINITIONS

n/a

4 TOOLS AND MATERIALS

4.1 General Description

- 4.1.1 The Lam 4600 is an automated dry etcher for etching metals such as aluminum and can be operated with either the top or bottom electrode powered. It will only process 6 inch wafers. The support equipment takes about 3 hours to heat up so it is important to plan ahead.

4.2 Wafer Boats

- 4.2.1 The Lam 4600 uses a set of dedicated black polypropylene cassettes which should remain with the tool.

5 SAFETY PRECAUTIONS

5.1 Hazards to the Operator

- 5.1.1 The etch process uses hazardous gases. Do not attempt to remove any machine covers and do not operate if any of the covers are already off. Read the material safety data sheets (MSDS) and be familiar with the hazards and safety controls to prevent an accident before using the system.

- 5.1.2 The etcher uses high voltage RF power, which can result in burns or electrical shocks. Never operate the tool with the covers off.
- 5.1.3 The etcher uses mechanical drives which may create pinch hazards. Keep fingers and loose clothing away from moving parts. Do not attempt to manually remove a wafer from the system.

5.2 Hazards to the Tool

- 5.2.1 Contaminants – Wafers containing gold, copper or similar metals should not be introduced into the Lam 4600 to prevent cross contamination of other wafers. Photoresist should be well cured to prevent organic contamination of the system. The back sides of the wafers should be clean to prevent contamination of the transfer arms or wafer chuck.
- 5.2.2 Pinch Hazards – The Lam 4600 has doors on the entrance and exit loadlocks to admit wafers to the system. These doors can close with tremendous force to be able to resist the forces of atmospheric pressure. Attempting to remove jammed or broken wafers with tweezers or fingers may result in the doors pinching the foreign object, resulting in damage to the vacuum seals.



Figure 1-Lam 4600 and Chiller

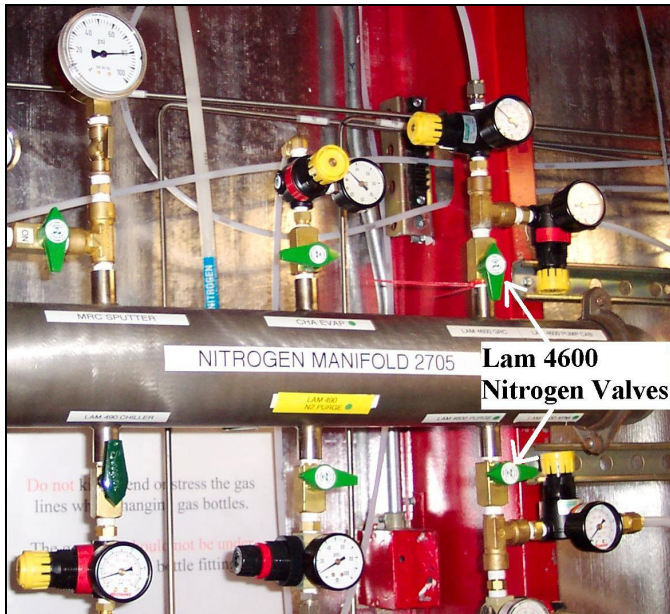


Figure 2-Nitrogen Manifold 2705 in chase

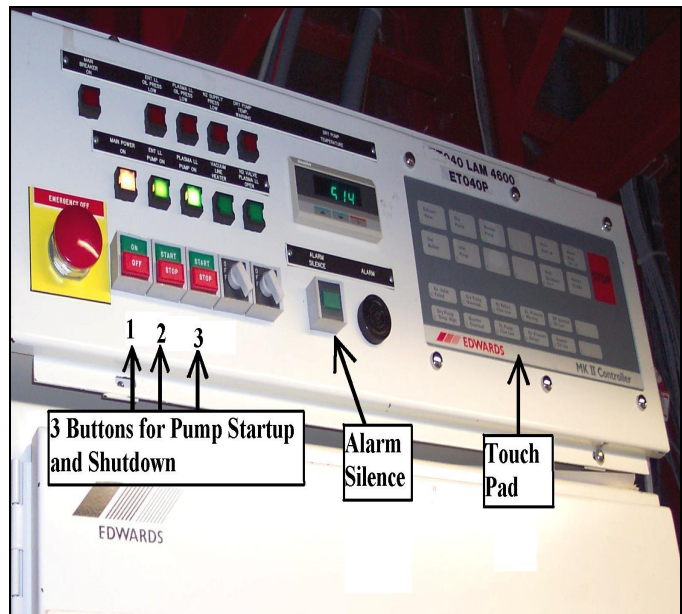


Figure 3- Edwards Pump Panel

6 INSTRUCTIONS

6.1 Initial Startup

- 6.1.1 The system is normally left off when not in use and requires about *3 hours* to heat up the gas reactor column (GRC).
- 6.1.2 Turn on the 2 nitrogen valves in the service chase on **Nitrogen Manifold 2705** that are labeled **Lam 4600 GRC** and **Lam 4600 Purge**. (Figure 2)
- 6.1.3 On the **Edwards Pump Panel** press the **On** button and the two **Start** buttons to start the pumps in the order 1-2-3. Press **Alarm Silence**. (Figure 3)
- 6.1.4 On the **Edwards Pump Panel** touchpad press **Remote disable** and then **Auto Start Up**. (Figure 3)
- 6.1.5 On the **GRC Panel** turn the system **On** with the red switch at the top (straight up) and press the **Reset** button. (Figure 4)
- 6.1.6 On the **GRC Panel** press **Beacon Cancel** to cancel the beacon. (Figure 4)
- 6.1.7 In the cleanroom the Lam 4600 should be on. To clear all of the alarms, press **Menu, 6, 2**. (Figure 1)
- 6.1.8 In the cleanroom verify that the Lam 4600 Chiller is on and press the **Reset** buttons to clear the red lights. If off, it will take 30 minutes to heat up and should read 60C on the upper and lower when at temperature. (Figure 1)
- 6.1.9 The system is ready when *all* red LED lights go out on the **GRC Panel**. (Approximately 3 hours) (Figure 4)
- 6.1.10 On the **Side Panel**, the **Interlock OK** indicator will come on when ready. (Fig. 5)

- 6.1.11 On the **Side Panel** press and hold the **Run On** button near the top right for 5 seconds until the **Run Mode** indicator light comes on. The system is now ready for processing. (Figure 5)
- 6.1.12 Record the inlet pressure of the GRC (lower right display) on the log sheet mounted to the door of the GRC



Figure 4- GRC Panel



Figure 5- Side Panel

6.2 Checking the Wafer Handler

- 6.2.1 Use one cassette loaded with six (6) dummy wafers to test for wafer handling errors.
- 6.2.2 Do NOT load any recipes. Make certain no recipes are currently loaded in the tool. If a recipe is loaded, unload the recipe.
- 6.2.2.1 To unload a recipe, press **Menu**.
- 6.2.2.2 Select **2** for Recipe.
- 6.2.2.3 Select **5** to clear recipe.
- 6.2.2.4 At prompt on the bottom of the screen press **1** for yes and then press **Enter**. Check that all values in the recipe had changed to zero (0).
- 6.2.3 Press the **Start** button. The tool will cycle through the wafers, but will not run a recipe.
- 6.2.4 If any wafer handling issues occur or a wafer gets stuck, contact the technician to fix the problem.

6.3 Loading a Recipe

- 6.3.1 On the Lam 4600 press the **Load** button. The current recipe name will be displayed. You may type in a new recipe number and press the **Enter** button to load the recipe. The **Select** key will abort.
- 6.3.2 Recipe names may be up to 8 numeric characters.
- 6.3.3 To view and edit press **2 Recipe** and then **1 Recipe**. Use arrow keys to move around the recipe and to make changes. Press the SEL key when finished. The changes that you make will be run during the process. Do not save over an existing recipe. Especially recipe number 1.

6.4 Running Recipes

- 6.4.1 Recipe 1 is set up as an end-pointed recipe for etching aluminum films that are more than 1 micron thick. Thinner films can be done by using a timed etch.
- 6.4.2 Clear any alarms. Select **Menu, 6, 2**.
- 6.4.3 Select **1 Status Page**.
- 6.4.4 Press the **Start** button to load and process the wafers. (The Load and Process Command is assumed and does not need to be selected.)
- 6.4.5 When finished etching, wafers should be *immediately* rinsed and dried to prevent corrosion.

6.5 Writing a Recipe

- 6.5.1 Recipes typically consist of 4 parts including Stabilization, Etching, Pump/Purge and End.
- 6.5.2 The parameters in each step that can be varied include pressure, gap spacing, flow rates, power and endpoint method.
- 6.5.3 Step completion can be determined by time, stability or endpoint.
- 6.5.4 To edit a recipe select **1 Recipe**.
- 6.5.5 Use the arrow keys and the number keys to make any changes.
- 6.5.6 Move the cursor out of the highlighted field and press the **Sel** button.
- 6.5.7 A **Time** step ends after the entered amount of time.
- 6.5.8 A **Stability** step ends when the entered parameters are stable. The Time used with this step will sound an alarm if stability is not reached when the time is up. The step may be terminated with the **5 EP CHM** command on the **Status Page**.
- 6.5.9 An **End** step will finish when the optical endpoint triggers. See Section 6.5.
- 6.5.10 To save a displayed recipe, press the **Save** button.
- 6.5.11 Type in a recipe name and press **Enter** to save. The **Select** key will abort.
- 6.5.12 For more information on recipe writing see attachment at end of document.

6.6 Endpoint Determination

- 6.6.1 The system uses optical or DC bias based endpoint detection.
- 6.6.2 **Channel** is used to select which endpoint channel will be monitored. **Channel A** is 520nm and **Channel B** is 703nm.
- 6.6.3 **Delay** is the amount of time before the system normalizes the signal. This allows the plasma to stabilize.
- 6.6.4 **Norm** is the normalization time. This is the amount of time the system uses to establish a reference level. This reference level will later be used as a basis for the endpoint.
- 6.6.5 **Norm Value** allows you to choose the value that the normalization is set to which allows greater resolution in endpoint triggering. By reducing the normalized value, a given drop in the signal will be a greater percentage of the whole.
- 6.6.6 **Trigger** is the percentage of the normalized value that will end the step. For example a 90% setting would endpoint when the signal drops 10% from the normalized value.
- 6.6.7 For more information see attachment at end of document.

6.7 Plotting an Endpoint Signal

- 6.7.1 On the **7 Plot** page, select **2 Setup A** to access the upper graph or **3 Setup B** to access the lower graph.
- 6.7.2 Use the cursor to move around and input the appropriate settings.
- 6.7.3 When finished press the **SEL** button.
- 6.7.4 **Saving a file on a diskette**
 - 6.7.4.1 Select **2 Copy Files** from the **Utility** page.
 - 6.7.4.2 Use the arrow keys and the **Enter** button to tag the files that you want to copy.
 - 6.7.4.3 Press the **SEL** button copy.
 - 6.7.4.4 If you want to convert a file from DAT to DIF format, select **8 DAT to DIF**, use the arrow keys and **Enter** button to select the file that you want to convert and then press the **SEL** button.
- 6.7.5 For more information see attachment at end of document.

6.8 Shutdown

- 6.8.1 Before shutting down the system, verify that there are no wafers in the system. If you need assistance please contact the technician.
- 6.8.2 Press **Run Off** on the **Side Panel** in the chase. (Fig. 5)
- 6.8.3 Press **Auto Shutdown** on the **Edwards Pump Panel**. (Fig.3)
- 6.8.4 Wait 20 minutes for the **Auto Shutdown LED** to stop blinking. (Fig. 3)
- 6.8.5 On the **Edwards Pump Panel** starting with the right most button, press **Stop, Stop** and **Off** in the order 3-2-1. (Fig.3)
- 6.8.6 On the **GRC Panel**, turn off the scrubber with the red switch at the top. (Fig.4)
- 6.8.7 In the service chase, turn off the **Lam 4600 GRC** nitrogen and the **Lam 4600 Purge** nitrogen on the **Nitrogen Manifold 2705**. (Fig. 2)

6.9 Resetting the System

- 6.9.1 To silence an alarm press **Menu, 6, 3**.
- 6.9.2 For **Wafer Cleanout** select **1 Status, 1 Options, 2 Wafer Cleanout** and then press **Start**. Wafer Cleanout will take a while since it checks each station on the tool.
- 6.9.3 For all other problems contact a staff member.

6.10 Errors during Run

- 6.10.1 If a wafer gets stuck, do not attempt to remove it. Contact the tool technician.
- 6.10.2 If the RF does not come on during the run, make sure the tool is swiped in and that the chiller is completely on.
- 6.10.3 If the gases do not come on or they shut off early, make sure the **Run Mode** button in the chase is on. Check the DOD TOXIC GAS MONITOR to ensure the latch is made (Yellow Light in red gas control box by LPCVD). If not contact staff.

7 ATTACHMENTS

- 7.1 Recipe 1- for etching 1 um of Aluminum
- 7.2 Recipe Writing Guide (p. 2-23 to 2-28)
- 7.3 Signal Tracking and Plotting (p. 2-57 to 2-66)
- 7.4 Plot Page Operation (p. 3-28 to 3-31)

8 APPROPRIATE USES OF THE TOOL

- 8.1 Wafers containing gold, copper or similar metals should not be introduced into the Lam 4600 to prevent cross contamination of other wafers. Photoresist should be well cured to prevent organic contamination of the system. The back sides of the wafers should be clean to prevent contamination of the transfer arms or wafer chuck.
- 8.2 This etcher is intended for etching aluminum and other metal films.

R·I·T

Title: Lam 4600

Semiconductor & Microsystems**Fabrication Laboratory****Revision: E****Rev Date: 04/06/2017****REVISION RECORD**

Summary of Changes	Originator	Rev/Date
Original Issue	Sean O'Brien	A-08/02/04
6.1.7 and 6.1.8 modified, 6.7 changed to leave tool on after use, added 6.8.2, modified 6.9	Sean O'Brien	B-01/25/2007
Added 6.2 for Wafer Handling test. Modified 6.3.3 instructions	Kelly Johnson	C-10/20/2010
Added 6.1.12 for recording GRC inlet pressure	John Nash	D-07/03/2013
Added DOD TOXIC GAS MONITOR note	Bruce Tolleson	E-04/06/2017